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Detection and Optimization of Cardiac Markers Based on High Sensitivity C-Reactive Protein

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Abstract: Cardiac markers play an important role in prognosis and follow-up treatment. Therefore, it is of great practical significance to study the detection methods of high-sensitivity C-reactive protein cardiac markers. The purpose of this paper is to study the optimal method for the detection of cardiac markers of high-sensitivity C-reactive protein. In this paper, the significance of cardiac markers and high-sensitivity C-reactive protein and the relationship between them and myocardial infarction were first described. The BCA method for the purification and identification of C-reactive protein was studied, and then the determination and optimization of high-sensitivity C-reactive protein and high-sensitivity C-reactive protein in healthy people were further understood. To explore the application of serum high sensitive C-reactive protein in the detection of cardiac markers in 50 patients with acute myocardial infarction and 50 healthy people. The results showed that the experimental group was (21.57 ± 1.50), (37.62 ± 1.66), (529.20 ± 5.72), (95.79 ± 6.24) ng / ml, the control group was (0.90 ± 1.10), (1.71 ± 0.14), (35.25 ± 4.21), (0.99 ± 0.71) ng / ml, and the difference between the two groups was statistically significant ($P < 0.05$).

Keywords: Heart Marker; High Sensitivity C-reactive Protein; Detection Method; Myocardial Infarction

1. Introduction

CRP production is related to the stimulation of other inflammatory factors[1-3]. When the structure damage, microorganism entry, antibody reaction, stress reaction and malignant tumor can stimulate the rapid increase of C-reactive protein synthesis, so that the concentration of C-reactive protein increases thousands of times. It is a globulin with molecular weight of 1-140 KD[4-5]. If CRP continues to rise, it indicates chronic inflammation, which may also be caused by autoimmune diseases[6]. The increase of hs CRP in blood is a useful predictor of near and peripheral vascular diseases. Although there is a close relationship between blood lipid and coronary heart disease, nearly 50% of patients with myocardial infarction have no hyperlipidemia, which is a common mechanism difficult to explain[7-9]. Cardiac markers are also significant in evaluating prognosis and follow-up treatment. Therefore, it is of great practical significance to study the detection methods of high-sensitivity C-reactive protein cardiac markers.

Sujaya Gupta study assessed CRP levels in patients with and without periodontitis and their relationship to BMI and smoking behavior. Serum CRP was taken before periodontal treatment, and SPSS 17 software was used for data analysis. Results: the mean level of CRP (5.8595mg / L) in periodontitis group was significantly higher than that in non periodontitis group (1.1214mg / L)

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(P = 0.000). BMI and CRP had no correlation, but they were related to periodontitis. There was no significant relationship between smoking behavior and CRP (P = 0.344) and periodontitis (P = 0.541). They found a highly significant correlation between periodontitis and CRP levels, but not always with BMI and smoking. CRP was significantly increased in periodontal infection and was a marker of CVD. Therefore, it is recommended that doctors, periodontists and patients interact closely to prevent adverse health conditions[10]. Jonathan Buggey found that higher epicardial fat levels may be related to the duration of antiretroviral therapy and chronic inflammation, but not to other indicators of obesity, such as body mass index. They are associated with increased coronary calcium, myocardial perfusion defects, death, and myocardial infarction. The association with risk may be partly mediated by the direct action of cytokines and adipokines produced by adipose tissue. In addition, the increase of myocardial fat deposition in HIV infected patients is also related to the time of antiretroviral therapy[11]. Beata Moczulska studied pulse wave velocity (PWV) in patients with congestive heart failure and hypertension. The arterial hardness was measured by Mobil-O-Graph NG-PWA, and the pulse velocity (PWV) was estimated. Results: PWV in DHF group was significantly higher than that in control group. The average E / a value of heart failure group was significantly lower than that of non heart failure group. Conclusion: the oscillographic measurement of pulse wave velocity is noninvasive and lasts for several minutes without the presence of experts. Even in primary health care, patients at risk of diastolic heart failure can be identified early[12].

In this paper, the significance of cardiac markers and high-sensitivity C-reactive protein and the relationship between them and myocardial infarction were first described. The BCA method for the purification and identification of C-reactive protein was studied, and then the determination and optimization of high-sensitivity C-reactive protein and high-sensitivity C-reactive protein in healthy people were further understood. In this paper, 50 patients with acute myocardial infarction and 50 healthy people were selected to study the application of serum high-sensitivity C-reactive protein in the detection of cardiac markers. The experimental results showed that troponin was a marker of myocardial infarction. Troponin increased in 3-5 hours, peaked in 13-37 hours and lasted for 9 days. Its sensitivity is as high as 96%.

2. Proposed method

2.1 Heart markers

Seven million people die of cardiovascular disease every year. Cardiac markers have a good diagnostic effect on cardiovascular diseases. Because some cardiac markers are not widely used, it is urgent to strengthen the promotion of diagnostic methods of cardiac markers.

Cardiac markers, such as troponin, fatty acid binding protein and ischemia modified albumin (IMA), are also significant in evaluating prognosis and follow-up treatment.

2.2 Purification and identification of C-reactive protein

1) Determination of protein concentration by BCA

2) Preparation of standard curve sample: BSA 2.0mg/ml was diluted with PBS.

3) Add the sample collection solution into the enzyme plate and the working solution respectively, shake and mix well, then read the od595nm data through the enzyme reader, and calculate the concentration of each tubulin through the standard curve.

2.3 Hypersensitive C-reactive protein

Hypersensitive C-reactive protein and C-reactive protein belong to the same kind of protein. The difference between them is that the measured data of hypersensitive C-reactive protein is much higher than that of C-reactive protein. The principle of immunoenhancement turbidimetry was used for the detection of hypersensitive C-reactive protein, and the detection limit of CRP was more than 3-5mg · L^{-1} by immunotransmission turbidimetry or immunoscattering turbidimetry. In the presence of inflammation, the serum CRP level peaked 24-48 hours later, and the serum CRP level recovered to normal soon after inflammation elimination, with a half-life of 4-7 hours. The use of CRP in acute myocardial infarction and trauma and infection, and in surgery and cancer can significantly increase infiltration. Because CRP is not a stable characteristic, it

has high value in infectious diseases and connective tissue diseases. Through the discovery of cardiovascular events, it is necessary to exclude the injury of tissues, inflammation, tumor and infection in human body, and then measure the level of hs CRP. Hs CRP, as an acute reactive protein of IL-6, TNF and other cytokines, is an independent risk factor of coronary heart disease. It is generally considered that hs CRP < 1.0mg · L^{-1} is of low risk, 1.0-3.0mg · L^{-1} is of moderate risk and > 3.0mg · L^{-1} is of moderate risk. It is highly dangerous. Serum 40-160mg · L^{-1} in patients with myocardial infarction, the phenomenon of unstable angina will be higher gradually, and stable angina is also normal. Although CRP as a precursory target of coronary heart disease is supported, the increasing CRP data will be involved in the formation of atherosclerotic plaque, which will cause the phenomenon of unstable plaque rupture, which may be the sensitive index of inflammation.

(1) Hypersensitive C-reactive protein in healthy people

In general, hs CRP can detect the level of inflammation less than 0.20mg/l. The low level of inflammation detection has an important value in judging coronary heart disease, cerebrovascular disease and its risk.

(2) Determination and optimization of high sensitive C-reactive protein

Latex enhanced immunoturbidimetric method was used to improve the sensitivity and the accuracy in the low concentration range. High precision and reliability are required. Early agglutination is no longer used in most hospitals because of its poor accuracy. Immunoturbidimetry (including scattering method and transmission method) is also difficult to meet the requirements of hypersensitivity.

3. Experiments

3.1 Experimental data set

From September 2018 to March 2019, 501 patients were admitted to the Department of Cardiology. According to the inclusion criteria and exclusion criteria, 306 patients were selected. All patients passed the examination. There were 206 patients in the myocardial infarction group, including 100 males and 109 females, all of whom were 50.47 ± 8.32 years old. 206 patients in the control group, including 105 males and 104 females, had the same average age at 47.21 ± 9.97 years old, all patients had no other serious diseases. At the time of admission, each patient was inquired about the detailed medical history by the cardiologist and recorded the information including the age, gender, smoking, drinking, history of hypertension and diabetes to be investigated; each patient was examined carefully by the cardiologist, including: blood pressure level, weight, etc. Each patient underwent ECG and venous blood sampling 24 hours after hospitalization. The contents of blood examination include: blood routine, aging of liver and kidney, changes of blood glucose, blood lipid, hs CRP, C1q and uric acid.

3.2 Detection of serum hs CRP

In this study, the value of hs CRP in the two groups of patients was detected by immunoturbidimetry, and the 7600 automatic biochemical analyzer, which was mainly equipped in the laboratory of hospital, was used as the measuring instrument for the micro quantitative detection of hs CRP. The high sensitive C-reactive protein reagent produced by Dade Behring Marburg GmbH was used for determination. The normal reference value range provided by the laboratory of the people's hospital was 0-2.1mg/l. According to the manual and the quality control system, double standard and double tube measurement methods were used. Finally, the hs CRP values of three groups of patients were statistically analyzed.

3.3 Instruments and equipment

Rt-2100c;

Constant temperature water bath box;

Hitachi 7170A automatic biochemical analyzer;

Kdc-40 medium and low speed centrifuges from Zhongjia, HKUST;

Medical dw-86w420 low temperature refrigerator;

Siemens axidm artis DFA X-ray angiography system;

Lead-7000 multichannel physiological recorder.

3.4 Statistical methods

All data are processed and analyzed by scientific statistical software. In this study, spssl9.0 software and X2 test method are used to calculate all counting data. If

the results are statistically significant, the difference will be more obvious.

4. Discussion

4.1 Comparison of isoenzyme concentration of cardiac markers between the two groups

The concentrations of high-sensitivity C-reactive protein, troponin I, myoglobin and creatine kinase isoenzyme in the experimental group were (529.20 ± 5.72), (95.79 ± 6.24) ng / ml, respectively, and those in the control group were (0.90 ± 1.10), (1.71 ± 0.14), (35.25 ± 4.21), (0.99 ± 0.71) ng / ml. the differences between the two groups were not significant but significant ($P < 0.05$), as shown in **Table 1**.

The results showed that the concentration of cardiac marker isoenzyme in the experimental group was significantly higher than that in the control group ($P < 0.05$), suggesting that there was a positive correlation between myocardial infarction and cardiac marker isoenzyme. Through the simultaneous detection of the four, we can find the early symptoms of myocardial infarction, which is very important for early diagnosis. However, the level of myoglobin in human body will gradually increase 3 hours after the onset of the disease, but the rejection to the heart is not high, and it is a marker of myocardial injury (generally speaking, the symptoms occur within 7 hours, and the level of myoglobin in the blood will gradually increase). However, we can find that another damage will be creatine kinase isoenzyme. The activity of this enzyme is related to the location, area and prognosis of myocardial infarction. This enzyme has been used as a marker of myocardial injury, but its flexibility is not high, its discrimination is poor, it is difficult to distinguish from skeletal muscle disease and injury, it is difficult to diagnose small myocardial infarction, often false-positive and false negative, it can not be used alone in clinical.

	Hypersensitive C-reactive protein	**Troponin I**	**Myoglobin**	**Creatine kinase**
Test group	21.57±1.50 ng/ml	37.62±1.66 ng/ml	529.20±5.72 ng/ml	95.79±6.24 ng/ml
Control group	0.90±1.10 ng/ml	1.71±0.14 ng/ml	35.25±4.21 ng/ml	0.99±0.71 ng/ml

Table 1. Comparison of isoenzyme concentrations between the two groups

4.2 Comparison of the positive rate of cardiac marker isoenzyme between the two groups

The positive rates of high-sensitivity C-reactive protein, troponin I, myoglobin and creatine kinase isoenzyme in the experimental group were 83%, 78%, and 49%, respectively, while those in the control group were 5%, 0%, 0%, 0% and 0%, respectively. The positive rates of cardiac marker isoenzyme were statistically significant ($P < 0.05$), as shown in **Figure 1.**

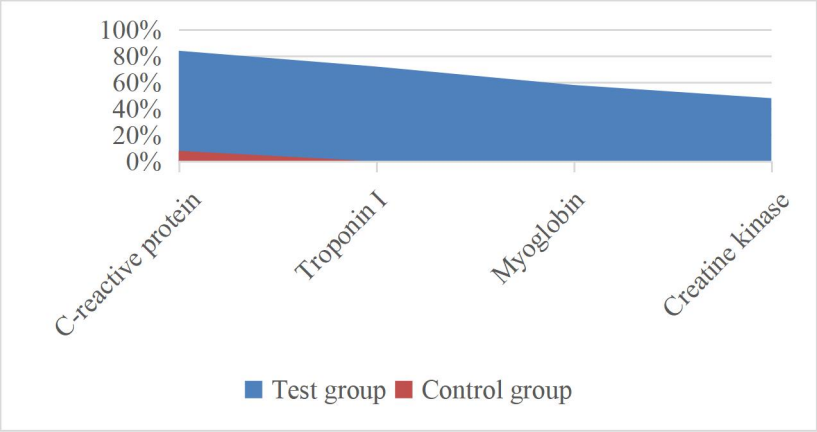

Figure 1. Comparison of isozyme positive rates between the two groups.

Troponin is a marker of myocardial infarction. Troponin increased in 3-5 hours, peaked in 13-37 hours and lasted for 9 days. Its sensitivity is 96% and specificity is 99%. It is the best marker of myocardial infarction. The influence of cardiac markers and high sensitive CRP in patients with acute myocardial

infarction will lead to the occurrence of the disease. The results of high sensitive CRP in patients with acute myocardial infarction were more than 8, which exceeded the normal index. This may be due to the abnormal cardiac markers, resulting in the increase of CRP test results. The increase of CRP can cause acute inflammatory reaction, and form cardiovascular atherosclerosis and acute myocardial infarction.

5. Conclusions

In this paper, 50 patients with acute myocardial infarction and 50 healthy people were selected to study the application of serum high-sensitivity C-reactive protein in the detection of cardiac markers. Through the study of CRP, the experimental group was (21.57 ± 1.50), (37.62 ± 1.66), (529.20 ± 5.72), (95.79 ± 6.24) ng / ml, the control group was (0.90 ± 1.10), (1.71 ± 0.14), (35.25 ± 4.21), (0.99 ± 0.71) ng / ml, and the difference between the two groups was statistically significant ($P < 0.05$). The abnormality of cardiac markers was observed, and the effect of CRP level change on the condition was analyzed to a certain extent. It was also an acute heart disease Main monitoring items of patients with myocardial infarction.

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